Space Weather Technical Forecast

Issued on Friday, 16 August 2024 at 01:22 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-class flares expected, a chance of X-class flares. G1-G2 Minor to Moderate storms on day 2 (17 Aug) due to CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Moderate with one M-class flare, peaking M1.1 at 15/0348 UTC from AR3780. There are nine regions on the visible disc, with the most notable remaining AR3784 in the north-centre, which is a moderately sized compact region with a complex magnetic structure, including a strong delta configuration and an east-west inversion line. Earlier in the period the umbral area of the spot increased, especially around the delta spot, along with some small surrounding spots emerging. Later in the period the leading small surrounding spots started to fade, while a small rotational movement of the small spots within the main umbra occurred. AR3780 remains a large and complex region approaching the southwest limb, but with some apparent weakening, although this could be due to the increasing viewing angle. The remaining regions are smaller and generally less complex and stable, although a new region is currently emerging from the southeast limb and has the potential to be moderately magnetically complex.

No Earth-directed CMEs were observed leaving the Sun in this period.

Solar Wind / Geomagnetic Activity: Mainly slow wind conditions were observed by ACE at L1, although briefly slightly elevated levels occurred with a peak of 412 km/s at 15/0245 UTC. Density was around average. The Interplanetary Magnetic Field, Bt ranged from Weak to Moderate, from 6-9nT, but was predominantly Moderate through the day. The north-south component, Bz, was positive for much of the time but did temporarily dip southwards to reach a minimum of -4nT around 15/1244 UTC. Phi angle generally negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 remained at background below the S1 Minor Radiation Storm threshold. High energy electron flux (greater than 2MeV) observed at GOES16 was at background. The 24-hour fluence was below the Active threshold, with 5.27e6 integrated pfu observed at 16/0000 UTC, with a rising trend.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to High solar activity is forecast, with M-class flares expected and a chance X-class flares. There is slight chance of an isolated X10+ flare from AR3784 (R4-R5 Blackout).

Solar Wind /Geomagnetic Activity: A faint, partial halo CME occurred due to the X1.1 flare at 14/0640UTC, and is forecast to arrive at Earth day 2 (17 Aug). The strength of any impact is low confidence however, with the main geomagnetic activity likely with any subsequent magnetic cloud. This has the potential to be further enhanced by the fast wind of CH58/- on the north-disc, however

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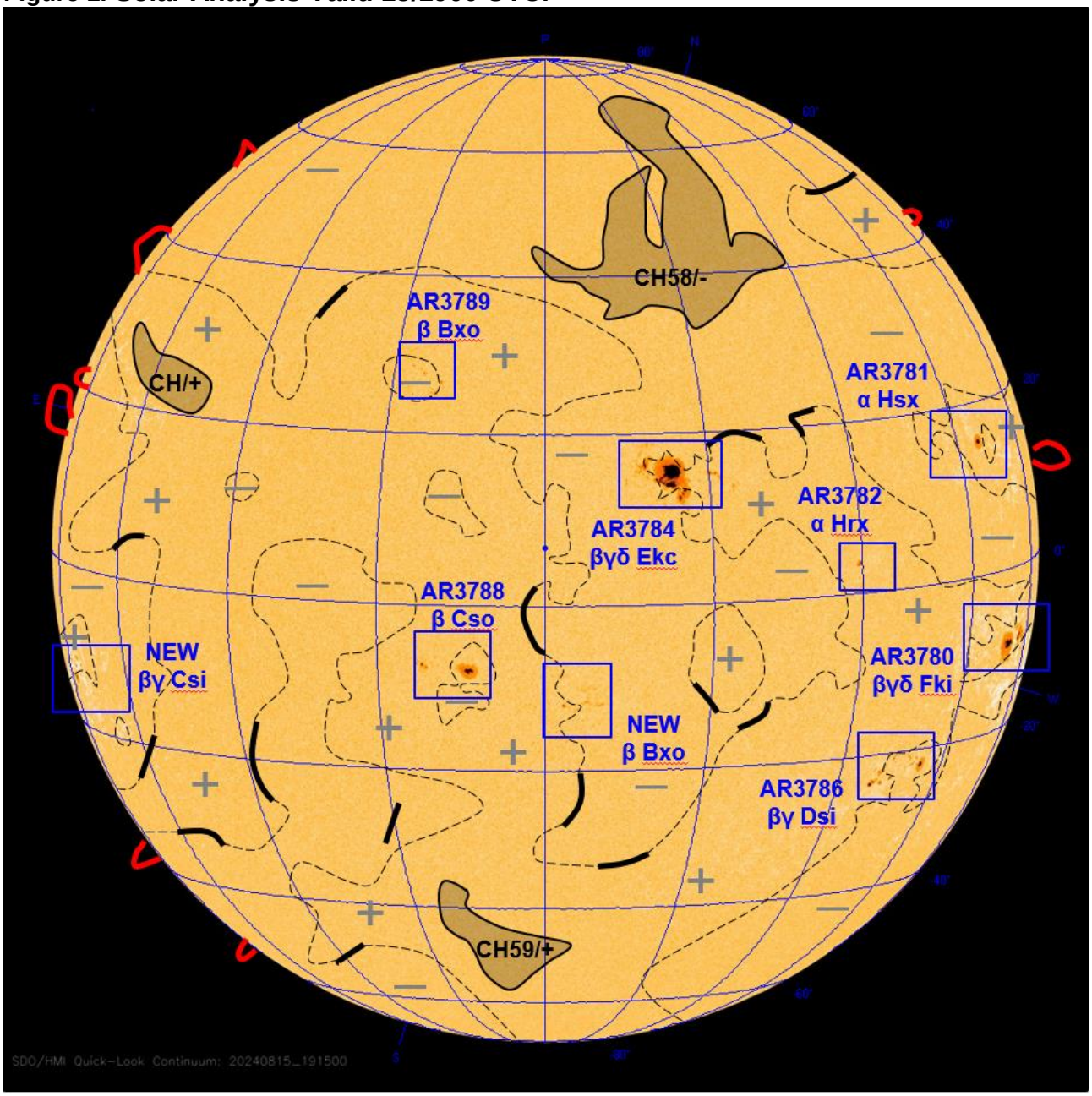
this is most likely to remain north of Earth. Mainly Quiet geomagnetic activity at first is expected to become Active to G1/G2 Minor to Moderate Storm on day 2 (17 Aug) due to any CME arrival, with a slight chance of reaching G3 Strong Storm. Activity then eases through day 3 (18 Aug).

Energetic Particles / Solar Radiation: High energy proton flux is most likely to remain at background, but with a chance of rising in response to any notable flares. This gives a chance of reaching the S1 Minor Solar radiation storm level, and perhaps towards the S3/Strong Solar Radiation Storm threshold if any significant flares from previous region AR3784 were to occur. The high energy electron flux is forecast to be mostly at background with the associated 24-hour fluence remaining below the Active threshold (1e8 integrated pfu), despite an upward trend.

Figure 1. Solar Analysis Valid 15/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

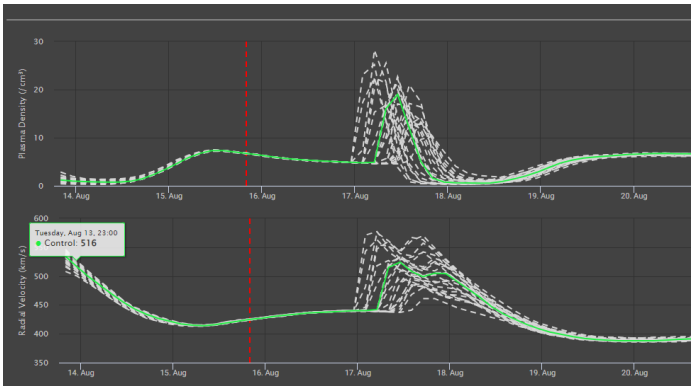
A faint, partial halo CME associated with the X1.1 flare at 14/0640UTC has been assessed as having an Earth-directed component, likely arriving at Earth on day 2 (17 Aug), however, confidence is low. Given the relatively slow speed of the CME, the initial impact may be rather limited, with the majority of the geomagnetic activity most likely with the subsequent magnetic cloud.
While the fast wind from negative polarity coronal hole 58 is most likely to pass north of the Earth-Sun line, there is also some potential for an arrival alongside or shortly after the CME, on day 2 (17 Aug). This may further enhance any geomagnetic activity, however confidence is low as this recurrent coronal hole feature did not connect with Earth on the previous rotation and also remains north of Earth on MOSWOC Enlil.
Geomagnetic activity is expected to be mainly Quiet until the the arrival of the CME tomorrow (17 Aug). G1-G2/Minor-Moderate storms are likely, with a slight chance of G3/Strong storm storms. These conditions continuing into day 3 (18 Aug), before easing through the day.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	70	40	1
Strong	G3	No	1	5	1	1
Severe	G4	No	1	1	2	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1400	Partial	X1.1 flare	AR3784	610 km/s	17/0800 UTC -6hrs/+ 12 hrs	Low confidence

Figure 2: Latest MOSWOC Enlil ensemble forecast, showing the range of potential arrival times for the CME on the 17th.



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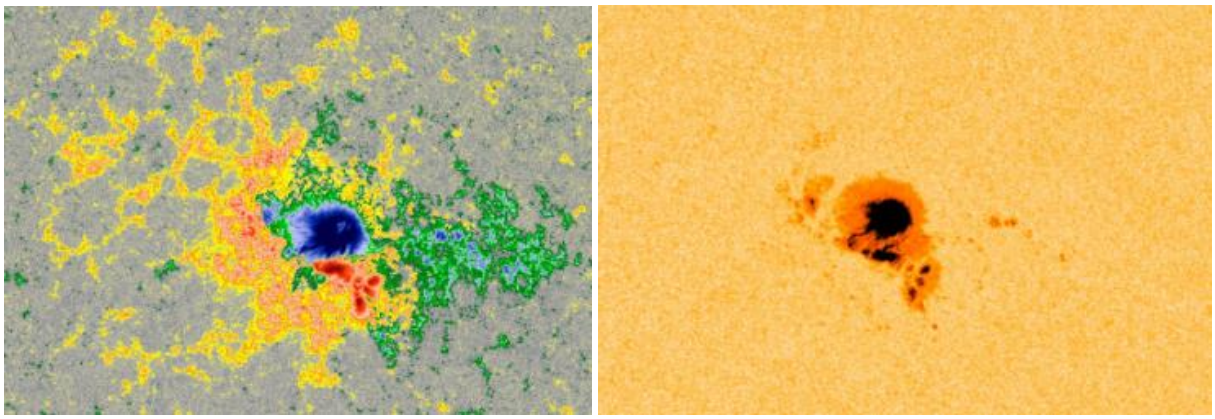
Radio Blackouts - X-Ray Flares:

Moderate to High activity, with further M-class flares expected and a chance of X-class flares. There is also slight chance of rising to Very High, due to AR3784 in the north-centre disc.

There are nine sunspot regions visible on the disc, with previous region AR3783 now faded from view. AR3784 in the north-centre is of particular note. This was the source of an X-class flare, on 14 Aug, and continues to show significant flare potential with a strong delta spot. The region also has an east-west aligned parity separation line, suggestive of notable shear across the region. However activity appears to have stalled, despite slight recent growth in spot number and complexity of the delta spot. AR3780 in the southwest is now approaching the limb, so becoming harder to assess, but is showing some apparent weakening, although it is uncertain how much of this is due to the increasing viewing angle. Therefore the previous analysis has been maintained. The other regions are all much small and simpler, except for the new region on the southeast limb. This region is the likely source of the M5.3 on 14 Aug, and appears to show some magnetic complexity.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	75	75	75	75
Very Active	R3 to R5 X Class	No	20	20	20	20

Figure 3: Latest SDO/AIA images of AR3784 (left magnetogram and right flattened intensitygram).



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Solar Radiation Storms - (High Energy Protons):

High energy proton flux, as observed by GOES-18 is at background and most likely to persist at this level. Notable flares will bring the potential for proton counts to rise, with the most likely source AR3784 in the north-centre disc, with this potential increasing as this region moves across the western disc. The sunspots approaching or just over the western limb, including AR3780 and AR3777, also bring a potential for proton productive flares, however this risk will reduce later in the period as these move further onto the far-side.
Overall, there is a chance of reaching the S1-level, and if any significant flare occurs there is a slight chance of reaching the S3 threshold.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	25	30	30	30
Very Active	**≥ S3 ***	No	5	5	5	5

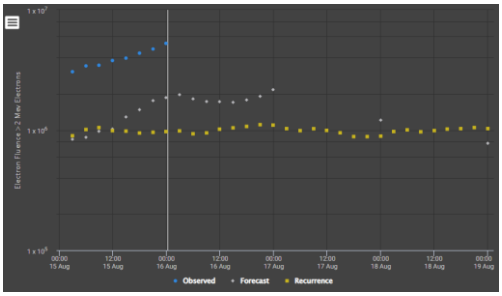
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

High Energy Electrons Event (≥ 2MeV):

High energy electron flux, as observed by GOES-16, is currently at background. The Strong and Severe geomagnetic storming on 12 Aug likely increased the electron flux at lower orbital shells, and there is still a potential for a response at GEO as this flux moves outward. Any increase is likely to be rather subdued, however, likely peaking at Moderate at diurnal maximum, and may not be observable much above background.
The associated 24hr electron fluence is therefore currently expected to remain below Active (1e8 integrated pfu) levels throughout, with MOSWOC REFM providing reasonable guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: Latest MOSWOC REFM model.



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